CERTIFICATE OF PROFICIENCY IN ASSAYING EXAMINATION
FIRE ASSAYING, SAMPLING AND SAMPLING THEORY,
AND STATISTICAL ANALYSIS

Total Marks: **180** June 8, 2007
Time Allowed **3 Hours** **All Calculations to be shown**
(Marks)

Q.1. **(20)** An exploration company has conducted a stream sediment reconnaissance survey of an area and would like your advice on analytical methodology for platinum and palladium assay at a low ppb level. They would like you to advocate a scheme of analysis that gives the state of the art detection limits and high precision for the precious metals. In stating your preference you must, for comparison purpose, rate all available techniques for this purpose and give an outline of each technique.

Q.2. **(15)** Let us assume that you have a new student assayer who will help you with the mundane tasks of fusion, cupellation, parting and annealing of a batch of gold concentrates from a gravity separation process. Although your assistant is familiar with general fire assay technique, explain to him what challenges the job entails. In your explanation you must point out the pitfalls of analyzing gold concentrates and how to avoid them.

Q.3. **(15)** Give in your own words, a complete yet succinct, definition of each of these terms used in fire assaying:

(a) Blick (b) Sprouting (c) Play of colours (d) Full feathered (e) Freezing

Q.4. **(15)** Calculate a suitable charge for crucible assay of the following (include sample weight): **Show all calculations.**

(a) Copper concentrate of chalcopyrite (75%) and quartz (25%).
(b) Black-sand containing equal portions of ilmenite and magnetite.

Q.5 **(20)** Answer any **five** of the following:

(a) How does speiss, formed in the crucible assay, affect the gold value?
(b) How does reduction of copper into the lead button affect cupellation temperature?
(c) What are the disadvantages of excess litharge in a flux?
(d) Name four most important properties of a satisfactory slag from a crucible fusion.
(e) If As and Sb are reduced into the lead button how would they affect cupellation?
(f) What is ‘proof gold’ and how would you prepare it?

Q.6 **(20)** French engineer Pierre Gy advanced the modern theory of sampling over three decades ago since then others like Viseman and Ingamells have made important contributions. Explain how an integrated framework of sampling designed to optimize uncertainty incorporates each of these theories starting with sampling of broken ore to reduction of sample suitable for laboratory tests. Give numerical components (equations) of each theory along with the your description of the integrated program.

Q.7 **(15)** Describe, **in detail**, the concept behind 'increment sampling' and explain why it is better to take many smaller increments while sampling a bulk commodity rather than a few large increments?

Q.8 **(15)** In the certification of a gold ore for the purpose of establishing a Standard Reference Material, two different laboratories submitted the following results:

Lab A (ppm Au)	Lab B (ppm Au)
3.25	3.25
3.19	3.33
3.26	3.24
3.27	3.19
3.30	3.27
3.19	3.32
3.22	3.30
3.23	3.18
3.22	3.31
3.25	3.28

Find: (a) Mean (b) Standard Deviation (c) Variance (d) 90% C.L (e) 95% C.L.
(f) Which laboratory produced more precise results?
(g) Given the final certified value was 3.23 ppm Au, is there a significant bias in the results at the 90% and 95% confidence level for either laboratory?

Q.9 **(10)** A number of statistical tests such as an "outlier test" and student's *t* test are used in treatment of analytical data. Answer any **two** of the following:
(a). What is a statistical outlier?
(b). Can one apply the outlier test to a data set more than once? Explain.
(c). What is the significance of a *t* test? What is it called when multiple *t* tests are used?

Q.10 **(10)** Cyanide leaching of gold ores is a common method of extraction in mining and laboratory environment. Describe the process using chemical equations and explain how the cyanide containing solution is made harmless before disposal in a laboratory.

Q.11 **(15)** Sample weighing 8250 g was crushed to pass 40 mesh sieve. After screening, 10.8 g of metallics were taken off, yielding 3.75 g of gold. A sample weighing 2000 g was taken from the 40 mesh pulp and crushed to pass a 120 mesh sieve. The 1.15 g of metallics from this screen yielded 0.772 g of gold. The 120 mesh pulp assayed 2.55 Oz/ton. Calculate the gold assay of the original sample in grams per metric ton.

Q.12 **(10)** Give a brief description of two commonly practiced methods of sampling a dore' bullion for assay purpose.